The effect of Lampara net on the catch rates and size of the fishing harvest of *Rastrineobola argentae* (Mukene) in selected parts of Lake Victoria, Uganda.

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A RESEARCH REPORT SUBMITTED TO THE DEPARTMENT OF BIOLOGICAL SCIENCES, FACULTY OF SCIENCE IN PARTIAL FULFILLMENT OF REQUIREMENTS FOR THE AWARD OF A BACHOLER OF SCIENCE TECHNOLOGY BIOLOGY OF KYAMBOGO UNIVERSITY

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Declaration:

I, Bassa Samuel, declare that this dissertation is my original work and has not been submitted for a degree in any other university.

Signature..... Date.....9th November 2015.....

Approval

I hereby certify that this this report has been submitted with my approval for examination.

Associate Professor Twesigye Charles

Signature:.....

Date....10-11-2015.....

Supervisor.....

Dedication:

I dedicate this work to my lovely son Swaya Mike (RIP) who passed away on 15th March 2010 in Jinja hospital and late daddy, Swaya Wilson Ziraba Muzale (RIP) left us in the month of October 8th 2001. May the Almighty rest their souls in eternal peace. Amen.

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List of Abbreviations and Acronyms

CPUE	Catch per Unit of Effort
IFMP	Implementation of the Management Project
LVFO	Lake Victoria Fisheries Organization
EDF	European Development Fund
SOPs	Standard Operating Procedures
LVFRP	Lake Victoria Fisheries Research project
Lampara net	The Net used to harvest Mukene fish samples.

Abstract

This study was undertaken in Napoleon gulf, and part of the off shore area of Lake Victoria Uganda in the landing site of Lufu in Buvuma district in the month of October 2015 for three days of sampling. It was conducted in four landing sites; Busana, Kikondo from Buikwe district and Lufu landing site from Buvuma district. The main aim was to determine the effect of Lampara net on the catch rate and size of the *Rastrineobola argentae* (Mukene) harvested on Lake Victoria using various mesh sizes. The study focused on the 5mm and 10 mm mesh sizes of the Lampara net. A total of 109 boats were sampled; from the 5 mm mesh sizes indicated catch rates of 78-200 kg/boat/day and yet for 10 mm mesh size was at 248 kg/boat day. Statistical tests were carried out on the these two mesh sizes using One way Anova and indicated in catches was (Anova $F=7.476$; $P<0.05$) and for the price values was (Anova $F=5.488$; $P<0.05$). This is an indication that despite the fact that the Mukene fishery is on the increase, a time will come when it also be depleted so a need to use the rightful fishing gear of 10mm mesh size is advisable for the biodiversity conservation.

CHAPTER ONE

INTRODUCTION

1.0 Background of the study.

The distribution of the Mukene fishing effort is influenced by the population structure and the demand of the fishery by the fisher community surrounding in the lake. The type of boat used and the size of the net may affect the size of the Mukene harvested by the fishermen in the Lake Victoria. Some of these factors have affected the exploitation rate of this fishery on Lake Victoria, a lake that is shared by many countries in East Africa.

Lake Victoria is the largest freshwater system in the tropics with minimum depth of 40 meters and maximum depth of 80 meters. The lake is located at the latitudes ranging from 0º 20´N to 3 º 0´, S and longitudes of 31º -34º, 53´E with an altitude of 1136 m. The whole lake has total surface area of 68,680 km^2 and maximum length is 400 km and minimum 320 km. It has water retention time of 140 years and catchment area of 193,000 km^2, which extends into Rwanda and Burundi (Okaranon, *et al.* 1999, Ntiba, *et al.* 2001 and Balirwa, 2007). Lake Victoria fisheries have experienced recognizable changes over the last seventy years or so. It is certain that in the early years of the Lake Victoria, adequate fisheries catches were obtained with little effort, from inshore areas alone, and with simple fishing gears and the fishing intensity was almost negligible (Kudhongania and Cordone, 1974 (a)&(b), Okaranon, *et al.* 1999).

Nile perch was introduced in Lake Victoria between 1950s and early 1960s from Lake Albert and Lake Turkana for the purpose of converting the less valuable haplochromine

cichlids into high quality table fish (Okaranon, *et.al* 1999, Mhitu and Chande, 2004, Taabu, *et al.* 2008(b)). Major changes in the species composition occurred in early 1980's following these introductions which led to an explosive population increase in the Nile perch (*Lates niloticus*) and *Caridina nilotica,* a small benthic shrimp. The population of Nile tilapia and indigenous small pelagic cyprinid *Rastrineobola argentea* expanded substantially at about the same time. The present fishery is made up of mainly three commercial fish species, Nile perch, Nile tilapia and *Rastrineobola argentea.* Nile perch dominates the fishery followed by *Rastrineobola argentea* and Nile tilapia (Ligtvoet *et al.* 1995). The Lake Victoria basin currently supports 40 million people and 10% of this population depend on the lake especially fish either directly or indirectly. The gross economic product is in the order of US$4-6 billion annually (Kamanyi *et al.* 2006(a)&(b), Balirwa 2007, Muyodi *et al.* 2010, Report on Uganda Fisheries Frame survey 2008).

But as the Nile perch fishery has been dropping the Mukene fishery has been gaining and the biomass in the lake indicates that the lake has a lot that needs to be harvested. The shift in the cyprinid expansion while the cichlids declining emanates from the fishing effort that has been put on such fishes by the people of Uganda besides the predator prey relationship by the Nile perch. The growth rate of the cyprinids is very fast thus maturing in a short period of time as compared to others fishes thus leading to high biomass rate of this fish (NAFIRRI CAS Technical reports 2011 and 2012). But despite of that the fishers are using different sizes of nets (Lampara nets) to harvest this fish that could cause threat

to the fishery and hence may also be depleted like the Nile perch if such a case is not investigated.

1.1 Problem Statement

Rastrineobola argentae (Mukene) contributes significantly to the Ugandan economy. Recent studies indicate that the biomass of this fishery was 400,000 metric tonnes (Wanink 1998). But the biomass has been increasing steadily mean while the Nile perch biomass has been dropping (NaFIRRI CAS Tech. Reports 2011 and 2012). The use of various sizes of the Mukene seine nets (<5mm, 6-9mm and 10mm) in the lake is a major problem that needs to be evaluated since this is affecting the juvenile fish that are also harvested and thus could lead to loss of biodiversity. In this perspective scientific information is required on the right size of net to harvest Mukene in order to guide the fisheries managers. Therefore, this study was geared to provide the scientific information and a fisheries management guide in the *Rastrineobola argentae* (Mukene).

1.2. The General Objective

To determine the effect of Lampara net on the catch rates and sizes of the fishing harvest of *Rastrineobola argentae* (Mukene) in selected parts of Lake Victoria, Uganda.

1.2.1. Specific objectives

i) Determine the effect of Mukene seine net size on the catch rate and size composition of Rastrineobola *argentae* (Mukene).

ii) Determine the effect of the mode of operation used to harvest Mukene on the catch rate and size composition.

1.3. Hypotheses.

1. There is no effect of size of the net used for harvesting Mukene on the catch rate and size in, Lake Victoria Uganda.

2. There is no effect on the mode of operation on the catch rate and size composition of Mukene fishery.

1.4. Significance of the study

One of the major fishing methods used in the Mukene fishery is use of seine net. This method is increasingly becoming popular in the Uganda waters of Lake Victoria. In Uganda the fishers use both <5mm, 6-9 mesh size and also the 10mm mesh size nets in order to harvest Mukene. It has not been possible to determine the most suitable size of seine nets to be used in the Lake Victoria Mukene fishery. Hence there was need to determine the most suitable size seine net to be used in Lake Victoria waters basing on scientific experiments. In that way this study focused on addressing this matter and ensures that we provide scientific information for use in regulation of the Mukene fishery.

1.5. Scope of the study.

The study explored the relationship between the Mukene fishery and the size of the seine nets used in conjunction with the boat type and size. This work was carried out three days

in the Napoleon Gulf and one offshore site in Lake Victoria, Uganda, basically in the three major Mukene fisheries landing sites that were Kikondo, Busana in Buikwe district and Lufu in Buvuma district.

CHAPTER TWO

LITERATURE REVIEW

2.0 The Rastrineobola argentae

Rastrineobola argentae (*Mukene*) also referred to as Victoria perch belongs to the family Ciprinidae. Locally it is known as Omena (Tanzania and Kenya), and Mukene, Dagaa (Uganda) among the East African community and the Congo region. It is wide spread throughout the Ethiopian region, occurring in all the major river basins including the Nile, Chad, Senegal, Volta and Zaire. The light fishery for *Rastrineobola argentae* was developed in the mid-1960s and increased in 1980's currently forms the second most important fishery after the Nile perch in the Victoria basin (Witte *et.al* 1995). Five types of *Rastrineobola* fishery are currently being operated in the region of the Lake Victoria basin. These are; the beach seine, Scoop net, Lift net fishery (Lampara net), a boat operated encircling net fishery, the Catamaran net.

2.1 Spatial distribution of *Ratrineobola argentae*

It is anticipated that adults *Rastrineobola argentae* show a diurnal vertical migration. During the day they move as far as oxygen concentration allow. During the night the adults migrate to the surface layers. This fish species is parasitized by cestode (probably *Ligula intestinalis*) that are surface dwelling throughout day and night (Witte et. al 1995). There are indications that the mean size of the *Ratrineobola* population increases with water depth. The modal length of *Rastrineobola* increased from 4-4.5 cm SL at a station

of 2 m depth in the southern part of Mwanza Gulf to 4.5-5 cm SL at a station of 30 m depth near the entrance of the Mwanza Gulf (Witte *et. al* 1995). The Rastrineobola argentae is known to feed on zooplanktons thus play a crucial role in the changed ecosystem and fishery of Lake Victoria (Wanink J.H. 1998). The surveys carried out during hydroacoustic under the IFMP indicated that *Rastrineobola argentae* has been increasing steadily from 245,265 t, to 552,776 t from January 1999 to August-September 2001 respectively (Tumwebaze *et. al* 2008).

2.2 Size at first maturity.

Okedi (1973) reported that the size at L_{50} maturity of *R. argentae* at 6.3 cm TL (total length) for males and 5.4 cm TL for females. His study, he analyzed 604 specimens from Winam Gulf, Mwanza, Bukoba and Musoma and later on found a sex ratio of 53:34 (females/males). Then Wandera (1993) found out that the size at maturity of *R. argentae* in Pilkington Bay has been determined to be 40–41mm SL (standard length) for males and 43–44 mm SL for females (Wandera, 1993). Then in the Kenyan sector of Lake Victoria, the size at massive maturity has been estimated at 34 mm SL for males and 36 mm SL for females. Despite the fact that Wanink (1998) found values of 33 mm for females and 46 mm for males in (Manyala and Ojuok 2008). The changes in the size at first maturity could be an attribute of the different sizes of gear used and also the intensity of the Mukene harvest in Lake Victoria that was investigated.

CHAPTER THREE

MATERIALS AND METHODS

3.0 Study Area

The study was carried out on Lake Victoria, Uganda in selected parts of Lake Victoria including Napoleon gulf (Figure 3.1). The Napoleon gulf has a shoreline typical of Lake Victoria, indented with shallow bays at the lake margin. It is 1.5 km wide and its depth ranges between 1.5 and 19 m i.e. from the shoreline to deeper areas. It has too large permanent streams namely Bugungu and Budumbuli and some other small ones (Akumu, 1999, Bassa 2011). Most of the gulf shoreline is covered by vossia species and water hyacinth. Some shoreline areas are covered with *Cyperus papyrus* and *Phragmites*. The gulf is also surrounded with landing sites both in Buikwe district (formerly Mukono district) and Jinja district. Some parts of the gulf like the areas near Nasu point are a bit rocky. The study was carried out in this gulf basically due to accessibility and also the unique features explained above which also occurs in various areas of Lake Victoria. Sampling was carried out in landing sites which basically carryout Mukene fishery around Napoleon Gulf and these were, Busana (0.39062N, 33.25228E) and Kikondo (0.3995N, 33.21848E). Then on the off shore areas a landing site known as Lufu (00.20816N,33.41206E) in Buvuma district was identified to ensure that I compare results of fishers harvesting Mukene from offshore to those one inshore in the Gulf.

3.1 Experimental design.

The sampling unit was the fishing boats with the Mukene seine net every boat that was sampled. In the field sampling a measuring board of 50 cm total length, weighing scale of

100 kilogram were used. Formalin (10%) was also used to preserve fish that was analysed in the laboratory in order to determine to the sex maturity. In the study the type of propulsion was also collected in addition to number of fishermen per boat and also boat type whether it was Ssese pointed one end or Ssesse pointed both ends.

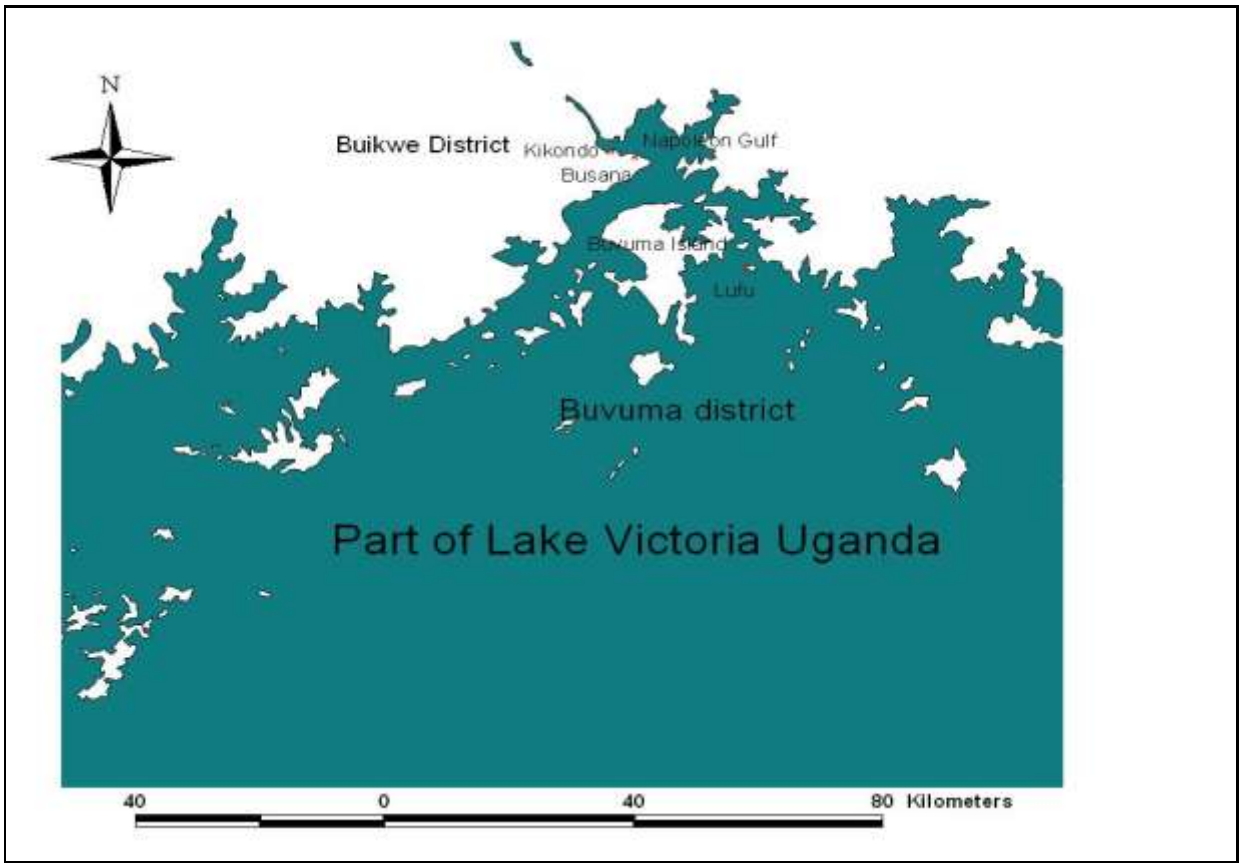

Figure 3.1: Shows the fish landing sites where Rastrineobola argentae samples were collected from the fishing boats on Lake Victoria Uganda.

3.6 Biometric data analysis

In addition to that samples were taken from various boats in order to undertake to length frequency and also biometric information in order to determine the growth rate

of the *Rastrineobola argentae* in relation to the size of the seine nets used. Data was collected in Busana and Kikondo landing sites in Buikwe district for four days in the months of June 2015. Data collection was done early in the morning starting from 6.00 am to 11.00 am. The sample collected was stored in 4% formalin. And further analysis on the sex, food and feeding and standard length was handled in the laboratory. The sampling followed the standard operating procedures of biological studies in the fisheries (SOPs, 2005).

3.7 Data Analysis.

Data input was handled by both Microsoft excel and SPSS package. Correlation was also carried in order to determine the level of significance. The length weight ($W= aL^b$) data was transformed to natural logarithm for regression (Sparre and Venema 1998). Both total mortality, fishing mortality and natural mortality was analysed. Beside that exploitation rate was also established. Catch rate and size composition was carried out basing on both percentage frequency and overall means. Where: $s*n^{1/2}$ = S.E and $t = t_{score}$ ($p<0.05$, two tailed tests) at (n-1) df, (Muhoozi 1998 and Flower and Cohen 1990). The data was subjected to statistical tests. Establishment of catch rates per boat type and size of the mesh of the seine net was done.

CHAPTER FOUR

RESULTS, DISCUSSIONS, RECOMMENDATIONS AND CONCLUSION

4.0 Results

A total of 109 boats in the 3 landing sites of Lufu in Buvuma district, Kikondo and Busana in Buikwe districts were sampled in for three days. The sampling basically targeted boats harvesting Rastrineobola argentae (Mukene) (Table 4.2). In the sampling two gear sizes of Lampara net were identified in the landing sites of Lufu 10 and 5 mm mesh sizes; though in the Kikondo and Busana they were using only one size of gear of 5 mm mesh (Table 4.1). Lufu landing site is found in the open waters of Lake Victoria and yet Busana and Kikondo is in the Napoleon Gulf of the Victoria waters hence these are in shore areas. Results indicated that the 5 mm mesh size ranged between 78-200 kg in average and in terms of price 520-548 shillings average price per kilogram. All the boats samples were using paddles for propulsion and had four (4) fishermen per boat and were Ssese pointed both sides and each was 8 meters by length. Size structure of different mesh sizes were done in order to see which lampara mesh size harvest mature sizes as compared to the other. And also in addition to the maturity ogives of the Mukene samples was also under taken. Hence these factors like propulsion, number of fish men, boat type and boat length were not tested a part from the factors of mesh size on the catch rate and size structure.

Results also indicated that fish from 10 mm mesh size of lampara net was maturing at 32 millimetre standard length for males and 30 millimetre standard length for females from the samples collected (Figures 4.1 and 4.2).

Table 4.1: The mean weight of *Rastrineobola argentae* (Mukene) in kg/boat/day and price in shillings

Gear type	Landing Sites	Av.Ras (kg)/boat/day	Av.price/kg (shs)/bat/day
	Busana	**78.57**	**548.00**
Lampara size (mm)	5	78.57	548.00
	Kikondo	**103.36**	**522.28**
Lampara size (mm)	5	103.36	522.28
	Lufu	**167.86**	**520.00**
Lampara size (mm)	5	200.00	520.00
Lampara size (mm)	10	148.08	520.00
	Grand Total	**111.01**	**526.80**

Table 4.2: Shows the Total number of *Rastrineobola argentae* (Mukene) boats sampled in kg and price in shillings in Kikondo, Lufu and Busana landing sites.

Gear type	Landing Sites	No. of boats (Ras-kg)	No. of Boats (Ras-price-shs)
	Busana	21	21
Lampara size (mm)	5	21	21
	Kikondo	**67**	**67**
Lampara size (mm)	5	67	67
	Lufu	**21**	**21**
Lampara size (mm)	5	8	8
Lampara size (mm)	10	13	13
	Grand Total of boats sampled	**109**	**109**

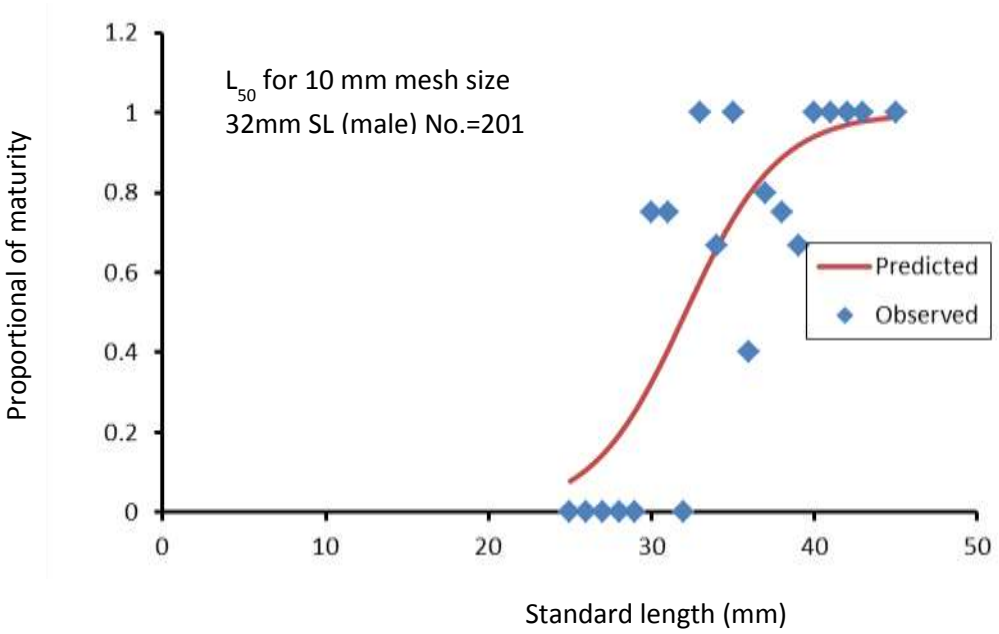

Figure 4.1: The size at L50 Maturity of *Ratrineobola argentae* at 32 mm of Male species from 10 mm mesh size with total number of 201 fish species.

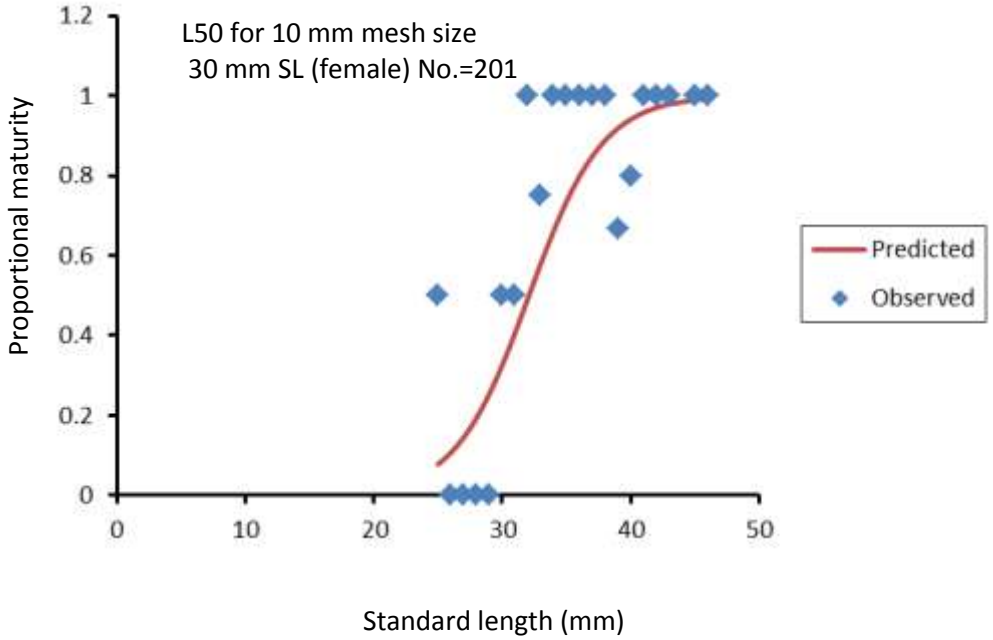

Figure 4.2: The size at L50 maturity of *Ratrineobola argentae* at 30 mm of Female species from 10 mm mesh size of Lampara net with 201 fish species.

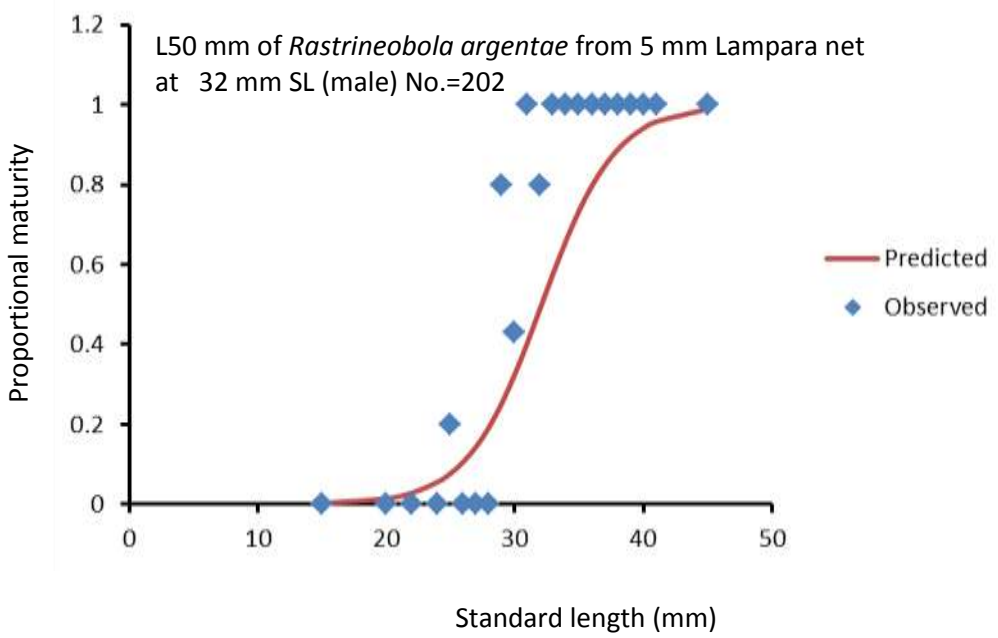

Figure 4.3: The L50 of *Ratrineobola argentae* from 5 mm mesh size of Lampara net at 32 mm Standard length (SL) of Male species with 202 fish species.

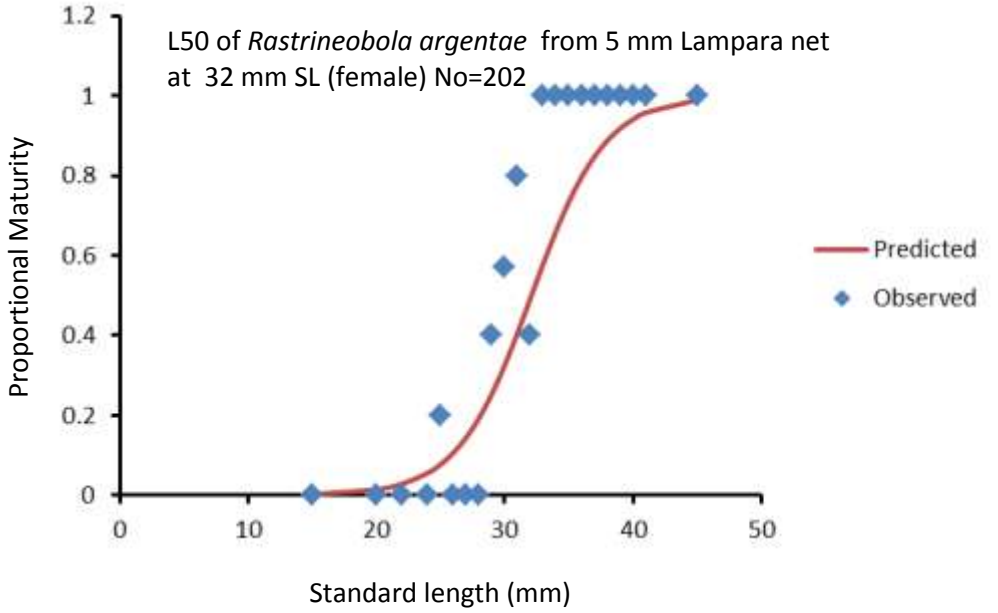

Figure 4.4: The L50 of *Ratrineobola argentae* from 5 mm mesh size of Lampara net at 32 mm Standard length (SL) of female species with 202 fish species.

Then for the 5 millimeter mesh size lampara net the fish was maturing at 32 millimeter standard length for both females and males respectively (Figures 4.3 and 4.4) as shown above The sex ratio for male to female was 1: 1 from both 5 and 10 mm mesh sizes

In terms of propulsion a total of 109 (One hundred and nine) boats sampled in the three landing sites, were operated using paddles. None of them was motorized neither sailed hence the results obtained were obtained from one type of boat operation from these three landing sites, Lufu in Buvuma district, Busana and Kikondo in Buikwe district.

A statistical test was carried out using single Anova indicated that there was a significant difference the lampara net mesh sizes in terms of catches with (P = 0.07) and on the prices with (P = 0.021) at 0.05 levels of significance (Table 4.3). In the Mukene fishery is carried out by both the men and the women. The men play the role of harvesting then the women handle the issue of post-harvest losses by drying the Mukene on the racks as indicated in some of the figures below (Figures 4.5, 4.6 and 4.7).

The size structure of the *Ratrineobola argentae* indicate that the 5 mm mesh size harvest from 15 mm standard length of the Mukene as compared to the 25 mm standard length from the 10 mm mesh size of the Mukene net (Lampara net) (Figures 4.9 and 4.10).

Table 4.3: The statistical tests carried out on Rastrineobola argentae (Mukene) in kg and price in shillings based on the mesh size of lampara net at 0.05 levels of significance.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Overall (Ras-kg)	Between Groups	20281.078	1	20281.078	7.476	.007
	Within Groups	290257.913	107	2712.691		
	Total	310538.991	108			
Av.price	Between Groups	682.153	1	682.153	5.488	.021
	Within Groups	13299.406	107	124.294		
	Total	13981.560	108			

Figure 4.5: Kikondo site one of the fishing villages that deal in the *Rastrineobola argentae* (Mukene) fishery on Lake Victoria Uganda in Buikwe district.

Figure 4.6: The way Mukene is dried using the drying rack to avoid post-harvest losses and value addition in Buikwe district.

Figure 4.7: The women engaged in the fisheries of *Rastrineobola argentae* (Mukene) in Kikondo landing sites on Lake Victoria, Uganda.

Figure 4.8: The binocular microscope used in the identification of the *Rastrineobola argentae* maturity.

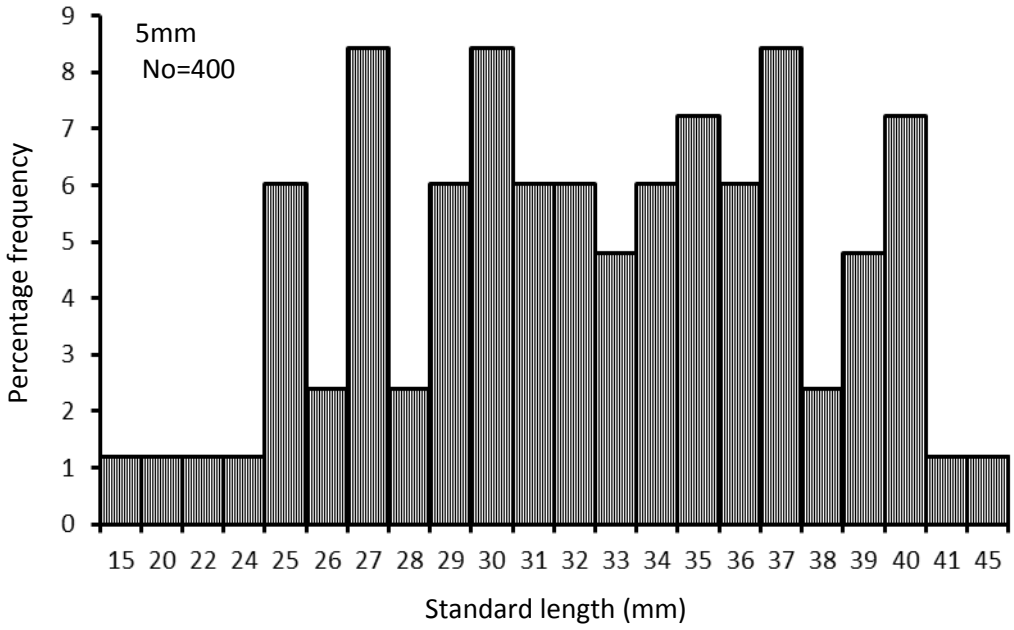

Figure 4.9: The size structure of *Ratrineobola argentae* harvested from the 5 mm mesh size Lampara net

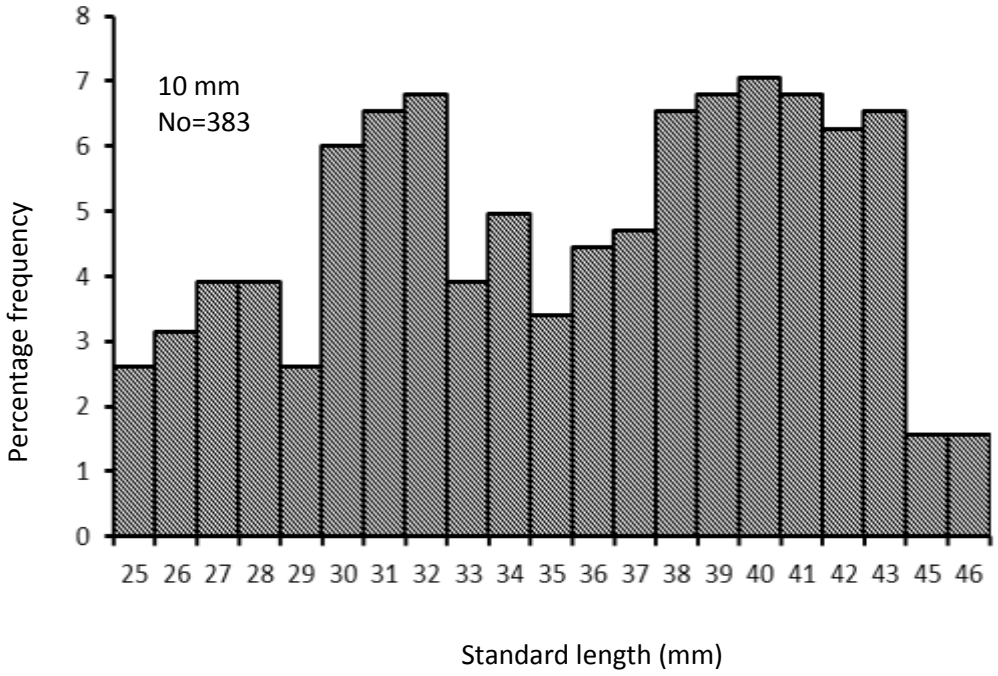

Figure 4.10: The size structure of *Ratrineobola argentae* harvested from the 10 mm mesh size Lampara net.

The modal class for the Mukene harvested form 5 mm lampara net was 30-31 mm SL yet for from the 10 mm net it was 31-32 mm SL.

5.0 Discussions

Rastrineobola argentae contributes a lot in terms of income and also as food security for the people of Uganda. This fish in the earlier days was not fished since there was a Nile perch boom. The catch rates of this fish has been ranging between 100-249 kg/boat/ day as per the catch assessment record of 2014 May sampling on Lake Victoria. These do not vary much with the information obtained in the sampled from the Napoleon Gulf and the Lufu landing sites in Buvuma district with in the range of 79-200 kg/boat/day.

The maturity ogives indicates to us that *Rastrineobola argentae* has been undergoing a change in the growth rate. Okedi (1973) indicated 6.3 cm TL and 5.4 cm TL for males and female respectively in Mwanza Gulf; then Wandera indicated to us that this same species was realised to grow at 40-41 SL mm and 43-44 SL for both males and females in Lingira waters, yet Manyala and Ojouk 2008 obtained 34 for males and 36 SL mm for females in the Kenyan waters. The current maturity ogives indicated that *Rastrineobola argentae* has had changes in the growth rate in 10mm lampara net with 32 mm SL and 30 mm SL for males and females respectively. Then in the 5 mm Lampara net it was 32 mm SL for both males and females. Changes in the maturity ogives indicate that there might be a high fishing pressure on this fish thus has to grow at an early stage to ensure its population is be maintained in the ecosystem despite the fact that its biomass is still high in the fishery. This is also depicted in the changes in the modal length of the Mukene fishery sampled as compared to (Witte et al 1995) with a figure of 4-4.5 cm SL as has dropped to 30-31 in 5 mm net and 31-32 in 10 mm lampara net. These changes indicate to us that though the fishery at the boom still scientists need to advise the fisheries manager how it should be regulated to ensure sustainability of this fish for both now and the future.

According to the NaFIRRI report of catch assessment indicated that the Mukene harvest on a monthly basis ranged from 9,445 -13,784 metric tonnes from Jul 2005 to May 2014, with catch rates of 100- 249 kg/boat day. On annual basis the catches registered on Lake Victoria were 106,000 – 166,000 metric tonnes with a value of 20,000 to 93,000 million

shillings right from the period of July 2005 to May 2014 Catch assessment experimental sampling on Lake Victoria, Uganda (NaFIRRI CAS report 2015). The catch per unit of effort results obtained from the study is not very far from the 2014 results from catch assessment report. This is an indication that it in reality that the Mukene fishery is growing steadily despite the fact of the fishing effort by the fishermen. In that case this fishery at the moment is helping the largest house hold in terms of income and feeding in the Lake Victoria basin and also in the low income homes in Uganda and abroad like the Congo, the Sudan, Tanzania and other regional countries. Regardless of the high values and high biomass of the Mukene fishery, this does not mean that man should just harvest Mukene anyhow using any methods of gears. A need to regulate the rightful mesh size of Lampara net to be used for harvesting the Mukene is of high importance that is addressed in this report.

5.1 Conclusions

Mukene fishery is on the boom on Lake Victoria and the fishers are using various fishing gears that need to be regulated. This study indicated to us that it would be advisable for the fishermen to use 10 mm lampara net as compared to the 5 mm net; to ensure sustainability of the fishery on Lake Victoria.

5.2 Recommendations

(a) Despite the fact that Mukene is still a lot in Lake Victoria, still there is a need to regulate the fishing gear size to ensure sustainability of the fishery and

biodiversity conservation in this case the Mukene fishing gears should be regulated.

(b) In that aspect it would be advisable for the fishers to use the 10 mm mesh size as compared to 5 mm mesh size that harvest a lot of immature *Rastrineobola argentae* (Mukene).

(c) Seasonal data collection and also increase on the landing sites harvesting Mukene would be needed in order to fully certify the use of the gear of 10 mm length and also the use of the stock assessment modal.

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